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(71) Applicant: **MINEBEA KABUSHIKI-KAISHA**
Kitasaku-gun, Nagano-ken (JP)

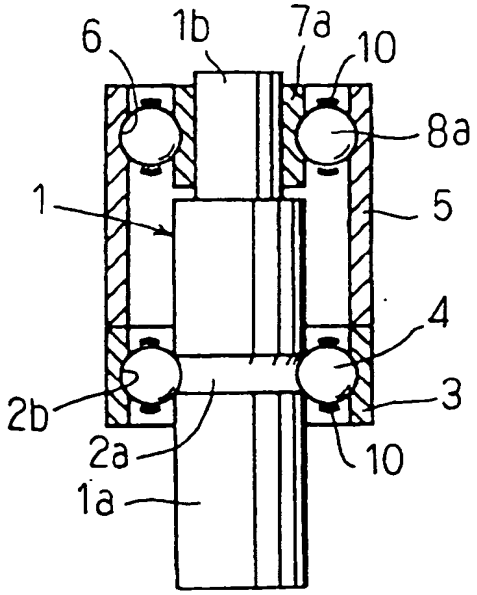
(72) Inventor: **Obara, Rikuro, c/o Minebea K. K.**
Kitasaku-gun, Nagano-ken (JP)

(74) Representative: **Warren, Keith Stanley et al**
BARON & WARREN
18 South End
Kensington
London W8 5BU (GB)

(54) Compound bearing assembly for the swing arm of a hard disc drive

(57) A compound bearing assembly for a swing arm (13) is disclosed, which comprises a stepped shaft (1) having a larger diameter portion (1a) and a smaller diameter portion (1b), the larger diameter portion (1a) having an inner raceway groove (2a) formed directly in the inner periphery thereof. A sleeve-like outer race ring (5) surrounds the stepped shaft (1) and has a distinct outer race ring (3) provided adjacent one end thereof and also has an outer raceway groove formed directly in the inner periphery of a portion adjacent the outer end thereof. A plurality of balls (4) are provided between the inner raceway groove (2a) and an outer raceway groove (2a) formed in the distinct outer race ring (3). A plurality of other balls (8a) are provided between an inner raceway groove formed in an inner race ring (7a) fitted on the smaller diameter portion (1b) of the stepped shaft (1) and the outer raceway groove (2b) formed directly in the inner periphery of the sleeve-like outer race ring (5).

F I G. 1



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Description

This invention relates to a compound bearing assembly for supporting a swing arm of a hard disc drive.

A prior art hard disc drive as shown in Figs. 4 and 5, comprises a magnetic disc 11 which is driven for rotation by a motor M, and a swing arm (or head arm) 13 carrying at the end thereof a magnetic head 12 for writing data in the disc 13 at a predetermined position thereof and reading out data from the disc 13 at a given position thereof.

The swing arm 13 has a stem rotatably supported by a compound bearing assembly which uses two ball bearing units. As shown in Fig. 6, a prior art bearing assembly for supporting the swing arm comprises two ball bearing units A and B and a sleeve-like spacer C. These components of the bearing assembly are produced separately and supplied to the user, e.g. the hard disc drive manufacturer or the swing arm manufacturer, to be assembled on a shaft D.

In other words, with the conventional swing arm support bearing assembly, the user has to assemble the two ball bearing units on the shaft separated by the spacer. This poses the following problems.

(a) The shaft has to be manufactured so as to match the inner diameter of the inner race rings of the ball bearing units. In addition, its rigidity is subject to restrictions.

(b) the spacer must be highly accurately produced, with parallel and flat opposite end finished surfaces.

(c) it is necessary to provide uniform contact between the opposite end surfaces of the spacer and the corresponding end surfaces of the outer race rings of the ball bearing units, thus requiring highly accurate finishing.

For the above reasons, the assembly is not easily assembled by the user.

An object of the invention is to provide a compound bearing assembly, which addresses the problems discussed above. It is an advantage of the present invention that the assembly can be used directly by a hard disc drive manufacturer for a swing arm of a hard disc drive.

In a compound bearing assembly for a swing arm according to a first aspect of the invention, a plurality of balls are provided between an outer raceway groove formed in the inner periphery of an outer race ring and an inner raceway groove directly formed in the outer periphery of a largediameter portion of a stepped shaft, which has the largediameter portion and a small-diameter portion, and a plurality of other balls provided between an inner raceway groove formed in the outer periphery of an inner race ring fitted on the small-diameter portion of the stepped shaft and an outer raceway groove directly formed in the inner periphery of an end portion of a sleeve-like outer race ring.

In a compound bearing assembly for a swing arm according to a second aspect of the invention, a plurality of balls are provided between an outer raceway groove directly formed in the inner periphery of an end portion of a sleeve-like outer race ring and an inner raceway groove directly formed in the outer periphery of a large-diameter portion of a stepped shaft, which has the large-diameter portion and a small-diameter portion, and a ball bearing unit having an inner and an outer race ring and a plurality of other balls provided therebetween has its inner race ring fitted on the small-diameter portion of the stepped shaft.

In a compound bearing assembly for a swing arm according to a third aspect of the invention, a plurality of balls are provided between an inner raceway groove directly formed in the outer periphery of a large-diameter portion of a stepped shaft, which has the large-diameter portion and a small-diameter portion, and an outer raceway groove formed in the inner periphery of an outer race ring provided around the large-diameter portion, and a ball bearing unit having an inner and an outer race ring and a plurality of other balls provided therebetween has its inner race ring fitted on the small-diameter portion of the stepped shaft with a sleeve-like spacer clampedly interposed between the outer race ring of the ball bearing unit and the outer race ring provided around the large-diameter portion.

According to the first aspect of the invention, the inner race ring fitted on the small-diameter portion of the stepped shaft has an equal outer diameter to the outer diameter of the large-diameter portion of the stepped shaft, so that all the balls are the same in diameter.

According to the second and third aspects of the invention, the inner race ring of the ball bearing unit has an equal outer diameter to the outer diameter of the largediameter portion of the stepped shaft, and the outer race ring of the ball bearing unit has equal outer and inner diameters to the outer and inner diameters, respectively, of the sleeve-like outer race ring, so that all the balls are the same in diameter.

Embodiments of the present invnetion will now be described, by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a sectional view showing a first embodiment of the compound bearing assembly in accordance with the invention;

Fig. 2 is a sectional view showing a second embodiment of the compound bearing assembly in accordance with the invention;

Fig. 3 is a sectional view showing a third embodiment of the compound bearing assembly in accordance with the invention;

Fig. 4 is a perspective view showing a hard disc drive;

Fig. 5 is a sectional view showing a swing arm supported by a compound bearing assembly in accordance with a first aspect of the invention; and

Figs. 6(a) and 6(b) are sectional views showing a prior art swing arm bearing assembly, Fig. 6(a) showing ball bearing units and a sleeve-like spacer before being assembled, Fig. 6(b) showing the ball bearing units and sleeve-like spacer having been assembled on a shaft.

Referring to Fig. 1 a first embodiment of the invention is illustrated, in which a stepped shaft 1 has a first portion 1a having a larger diameter than a second portion 16, the large-diameter portion 1a having an inner raceway groove 2a formed directly in the outer periphery thereof.

An outer race ring 3 is assembled on the larger diameter portion la of the stepped shaft 1 with a plurality of balls 4 provided between an outer raceway groove 2b formed in its inner periphery and the outer raceway groove 2a formed in the larger diameter portion 1a.

A sleeve-like outer race ring 5, surrounds the stepped shaft 1 and has an outer raceway groove 6b formed directly in the inner periphery of its outer end portion (i.e., an upper end portion in Fig. 1). The sleeve-like outer race ring 5 is assembled on the stepped shaft 1 with a plurality of balls 8a provided between the outer raceway groove 6b and an inner raceway groove 6a formed in the outer periphery of an inner race ring 7a fitted on the smaller diameter portion 1b of the stepped shaft 1.

The inner race ring 7a fitted on the small-diameter portion 1b of the stepped shaft 1 has an outer diameter equal to the outer diameter of the large-diameter portion 1a of the stepped shaft 1, so that the balls 5 and 8b are the same in diameter.

In consutructing the assembly, the inner race ring 7a, for instance, is initially slidably fitted on the smaller diameter portion 1b of the stepped shaft 1. Then, an adequate pre-load is applied to the outer end surface (i.e., upper end surface in Fig. 1) of the inner race ring 7a, and in this state the inner race ring 7a is secured by means of an adhesive to the smaller diameter portion 1b of the stepped shaft 1. In this way, the outer race ring 3, the sleeve-like outer race ring 5 and the inner race ring 7a are assembled on the stepped shaft 1.

In this structure, the sleeve-like outer race ring 5 and the outer race ring 3 are integrated into a compound member while the outer race ring 3, the sleeve-like outer race ring 5 and the inner race ring 7a are assembled on the stepped shaft 1.

As shown in Fig. 5, the stepped shaft 1 of the compound bearing assembly obtained in the above way, is projected from the base of a hard disc drive by securing the stem of its larger diameter portion 1a to the base. Then, a boss 14 of a stem of a swing arm 13 is fitted on and secured by means of an adhesive to the compound bearing assembly.

The swing arm 13 which is thus mounted on the compound bearing assembly is rotatable about the same.

Fig. 2 shows a second embodiment of the invention. Again in this embodiment, the larger diameter portion 1a of the stepped shaft 1 has the inner raceway groove 2a formed directly in the outer periphery thereof.

In this embodiment, a sleeve-like outer race ring 5 which surrounds the stepped shaft 1 has an outer raceway groove 2c formed directly in the inner periphery of an end portion (i.e., a lower end portion in Fig. 2) of it. The balls 4 are provided between the outer raceway groove 2c and the inner raceway groove 2a of the large-diameter portion 1a.

A ball bearing unit 7 which has an inner and an outer race ring 7a and 7b and a plurality of balls 8b provided therebetween, has the inner race ring 7a fitted on and secured to the smaller diameter portion 1b of the stepped shaft 1.

The inner race ring 7a of the ball bearing unit 7 has an outer diameter equal to the outer diameter of the larger diameter portion 1a of the stepped shaft 1, and the outer race ring 7b has outer and inner diameters equal to the outer and inner diameters, respectively, of the sleeve-like outer race ring 5, so that the balls 4 and 8b are the same in diameter.

In constructing the assembly, the inner race ring 7a of the ball bearing unit 7, for instance, is initially slidably fitted on the smaller diameter portion 1b of the stepped shaft 1. Then, an adequate pre-load is applied to the outer end surface (i.e., upper end surface in Fig. 2) of the inner race ring 7a, and in this state the inner race ring 7a is secured by means of an adhesive to the smaller diameter portion 1b of the stepped shaft 1.

In this way, the sleeve-like outer race ring 5 and the outer race ring 7b of the ball bearing unit 7 are made integral to be a compound member, and the sleeve-like outer race ring 5, and the inner and outer race rings 7a and 7b of the ball bearing unit 7 are assembled on the stepped shaft 1.

As described above, the stepped shaft of the compound bearing assembly thus obtained, is projected from a base of a hard disc drive by securing the stem of its larger diameter portion to the base, and then a boss 14 of a stem of a swing arm 13 is fitted on and secured by means of an adhesive to the compound bearing assembly.

Fig. 3 shows a third embodiment of the invention.

In this embodiment, an outer race ring 3 and a ball bearing unit 7 are provided on the larger and smaller diameter portions 1a and 1b of the stepped shaft 1, respectively, and a sleeve-like spacer 15 surrounding the stepped shaft 1 is fixedly interposed between the outer race ring 3 and the outer race ring 7b of the ball bearing unit 7.

The inner race ring 7a of the ball bearing unit 7 has an outer diameter equal to the outer diameter of the larger diameter portion 1a of the stepped shaft 1, and the outer ring 7b of the ball bearing unit 7 has outer and inner diameters equal to the outer and inner diameters, respectively, of the outer race ring 3 around the larger

diameter portion 1a, so that all the balls are the same in diameter.

In constructing the assembly like the preceding second embodiment, the inner race ring 7a of the ball bearing unit 7 is initially slidably fitted on the smaller diameter portion 1b of the stepped shaft 1, then an adequate preload is applied to the outer end surface (i.e., upper end surface in Fig. 3) of the inner race ring 7a, and in this state the inner race ring 7a is secured by means of an adhesive to the smaller diameter portion 1b of the stepped shaft 1.

In this way, the spacer 15 and the opposite end outer race rings 3 and 7b are made integral to be a compound sleeve-like outer race ring, and the outer race rings 3 and 7b, the spacer 15 and the inner race ring 7a are assembled on the stepped shaft 1.

Like the above first and second embodiments, the stepped shaft 1 of the compound bearing assembly thus obtained, is projected from a base of a hard disc drive by securing the stem of its larger diameter portion to the base, and a boss 14 of a stem of a. swing arm 13 is fitted on and secured by means of an adhesive to the compound bearing assembly.

The raceway grooves 9a and 9b are formed in the inner and outer race rings 7a and 7b of the ball bearing unit 7, respectively, and the balls 8a are held in place by ball retainers 10.

While in the above first to third embodiments the balls that were used were all the same in diameter, it is possible to use balls of different diameters on the sides of the larger and smaller diameter portions 1a and 1b of the stepped shaft 1, respectively.

With the compound bearing assembly for a swing arm constructed as described in the foregoing, the following advantageous functions and effects are obtainable.

(1) Since the components of the compound bearing assembly, i.e., the sleeve-like outer race ring or spacer, the inner race ring, the outer race ring, the balls and the snaft, are all assembled by the bearing assembly manufacturer, the user need not assembly any of these components, and the compound bearing assembly can be readily and reliably mounted on a swing arm of a hard disc drive by fitting the swing arm stem boss 14 on and securing the same by means of an adhesive.

(2) Since the larger diameter portion of the stepped shaft in the bearing assembly has the inner raceway groove directly formed in its outer periphery, the conventional inner race ring is unnecessary, and correspondingly the shaft is partly increased in diameter producing a stepped shaft, which thus has increased rigidity.

(3) Only a single conventional ball bearing unit, and hence only a single inner race ring, is needed, and it is possible to provide a bearing assembly having a reduced number of components.

(4) In the first and second embodiments of the invention, the sleeve-like outer race ring also serves as a spacer, and the conventional spacer is unnecessary, thus permitting reduction of the number of components.

(5) The sleeve-like outer race ring or the spacer is fabricated highly accurately by the bearing assembly manufacturer, thus improving the accuracy of the overall assembly.

Claims

1. A compound bearing assembly for a swing arm (13) of a hard disc drive comprising:

   a stepped shaft (1) having a first portion (1a) with a larger diameter than a second portion (1b), said larger diameter portion (1a) having an inner raceway groove (2a) formed directly in the inner periphery thereof;
   a sleeve-like outer race ring (5) surrounding said stepped shaft (1) and having a distinct outer race ring (3) provided adjacent one end and also having an outer raceway groove formed directly in the inner periphery of a portion adjacent the other end thereof;
   a plurality of balls (4) received in said inner raceway groove (2a) directly formed in said larger diameter portion (1a) and retained in an outer raceway groove (2b) formed in said outer race ring (3) or said outer raceway groove (2c) directly formed in said sleeve-like outer race ring (5); and
   a plurality of other balls (8a) received in an inner race way groove formed in an inner race ring (7a) fitted on said smaller diameter portion (1b) of said stepped shaft (1) and retained in said outer raceway groove (2b) formed directly in the inner periphery of said sleeve-like outer race ring (5) or an outer raceway groove (9b) formed in the inner periphery of said outer race ring (7b).

2. A compound bearing assembly as claimed in claim 1, wherein said balls (4) received in said inner raceway groove (2a) are retained in said outer raceway groove (2b) formed in said outer race ring (3), and said balls (8a) received in said inner raceway groove (6a) formed in said inner race ring (7a) fitted on said smaller diameter poriton (1b) are retained in said outer raceway groove (6b) directly formed in the inner periphery of said sleeve-like outer race ring (5).

3. A compound bearing assembly as claimed in claim 1, wherein said balls (4) received in said inner raceway groove (2a) are retained in said outer raceway

groove (2c) directly formed in the inner periphery of said sleeve-like outer race ring (5), and said balls (8b) received in said inner raceway groove (9a) formed in said inner race ring (7a) fitted on said small diameter portion (1b) are retained in said outer raceway groove (9b) formed in the inner periphery of said outer race ring (7b).

4. A compound bearing assembly for a swing arm of a hard disc drive comprising:

a stepped shaft (1) having a first portion (1a) with a larger diameter than a second portion (1b), said larger diameter portion (1a) having an inner raceway groove (2a) formed directly in the outer periphery thereof;
an outer ring (3) being provided around said larger diameter portion (1a);
a plurality of balls (4) provided between said inner raceway groove (2a) and an outer raceway groove (2b) formed in the inner periphery of said outer race ring (3);
a ball bearing unit (7) having an inner and an outer race ring (7a) and (7c) and a plurality of other balls (8b), said inner race ring (7a) of said ball bearing unit (7) being fitted on said smaller diameter portion (1b) of said stepped shaft (1); and
a sleeve-like spacer (16) fixedly interposed between said outer race ring (7b) of said ball bearing unit (7) and said outer race ring (3) around said larger diameter portion (1a).

FIG. 1

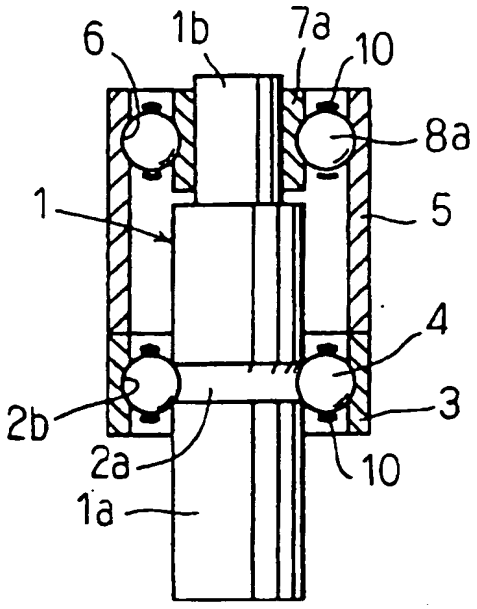


FIG. 2

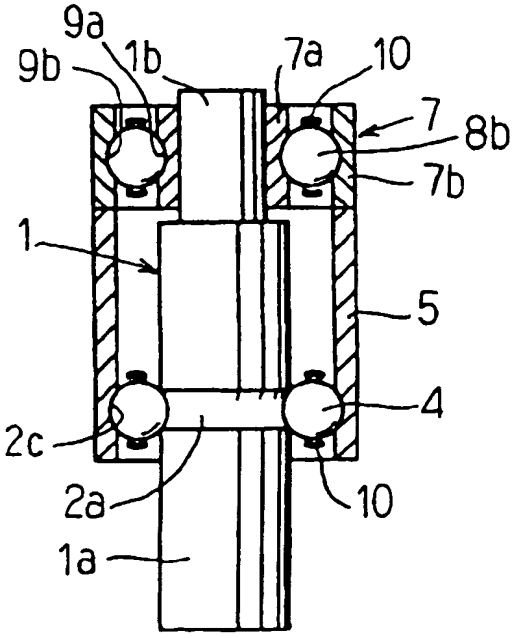


FIG. 3

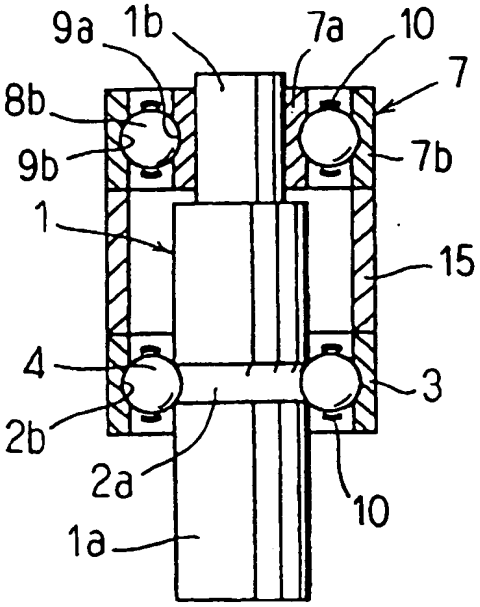


FIG. 4

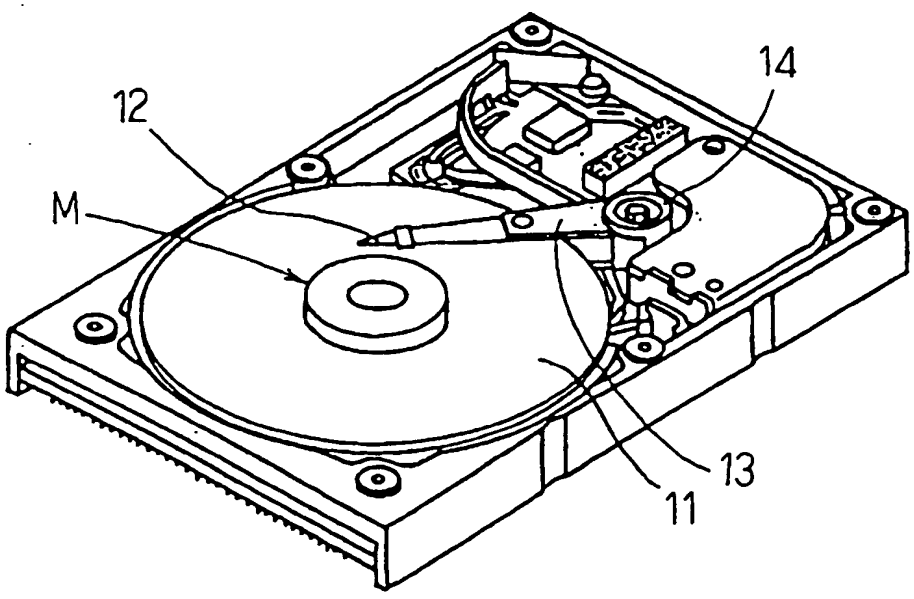


FIG. 5

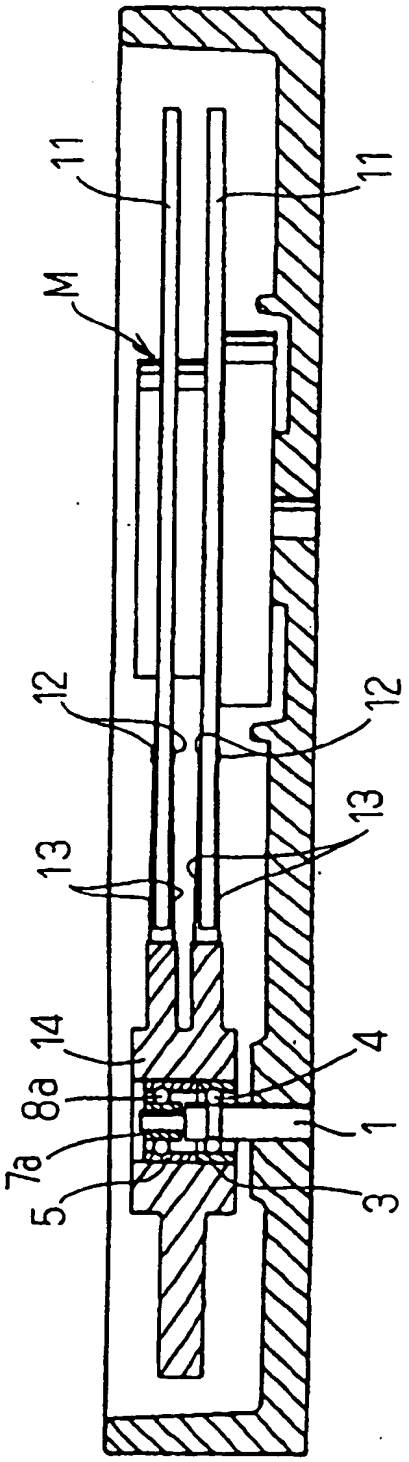


FIG. 6 (a)
Prior Art

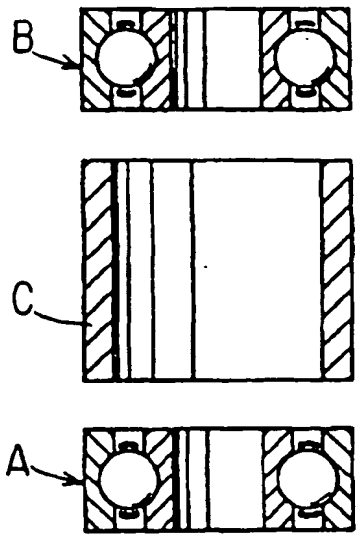
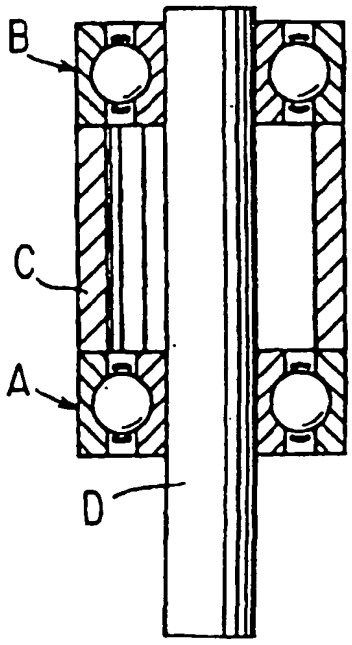


FIG. 6 (b)
Prior Art



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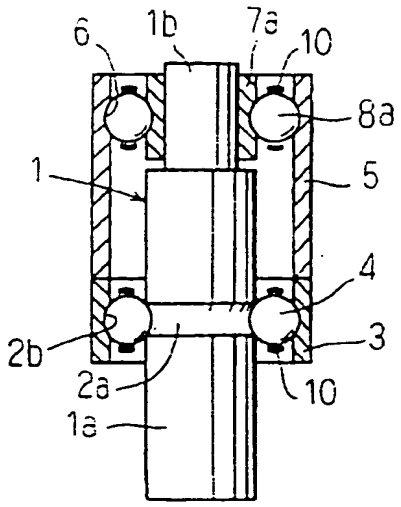
F I G. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 7656

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 5 341 569 A (TAKAMIZAWA) * column 6, line 64 - column 13, line 47; figures *	1-4	G11B21/12
X A	EP 0 613 134 A (MINEBEA) * page 3, column 3, line 58 - page 4, column 6, line 36; figures *	1 2,3	
X A	FR 2 565 017 A (GMN) * page 3, line 8 - page 4, line 17; figures *	1,4 2,3	
A	US RE34684 E (KITAHARA ET AL.) * column 4, line 56 - column 8, line 54; figures *	1-4	
A	US 5 099 374 A (OHKITA ET AL.) * column 4, line 11 - column 13, line 7; figures *	1-4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

G11B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 November 1997	Geoghegan, C

CATEGORY OF CITED DOCUMENTS

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